IN THE CLAIMS:

The text of all pending claims, (including withdrawn claims) is set forth below. Cancelled and not entered claims are indicated with claim number and status only. The claims as listed below show added text with underlining and deleted text with ~~strikethrough~~. The status of each claim is indicated with one of (original), (currently amended), (cancelled), (withdrawn), (new), (previously presented), or (not entered).

Please AMEND claims 1, 5, 8, 11-12, 14-46 CANCEL claims 2-4, 6-7, 9-10, and 13 in accordance with the following:

1. (Currently Amended) A ~~piston design support program~~computer readable medium encoded with a computer program for supporting design of a piston shape of an ~~internal combustion~~ engine, said program ~~makes a computer execute~~being executed by a computer to perform:

~~an input step of~~ inputting specification values ~~associated with~~defining a ~~piston~~crown shape of a piston and a shape and position of a valve;

generating a two-dimensional image representing the piston and the valve, using the specification values;

calculating a gap between the piston and the valve in the generated two-dimensional image;

~~a verification step of~~ verifying~~, based on the input specification values,~~ whether or not the calculated gaps between the piston and ~~surrounding components thereof are appropriate~~the valve in the generated two-dimensional image is not less than a predetermined value;

~~a read step of~~ reading out, ~~when~~after ~~it is determined in the verification step~~verifying that the gaps ~~are appropriate~~ is not less than the predetermined value, a three-dimensional standard piston model and valve model ~~which can be deformed according to a predetermined rule~~ from a database; ~~and~~

~~a deformation step of~~ deforming the piston model and the valve model on the basis of the specification values; and

determining whether or not the gap between the three-dimensional deformed piston model and the valve model is not less than the predetermined value.

2-4. (Cancelled)

5. (Currently Amended) ~~The program according to claim 1, wherein~~ A computer

readable medium encoded with a computer program for supporting design of a piston shape of an engine, said program being executed by a computer to perform:

inputting specification values ~~associated with~~defining a skirt shape of the piston and a shape and position of a connecting-rod ~~are input, and~~;

generating a two-dimensional image representing the piston and the connecting-rod, using the specification values;

calculating a gap between the piston and the connection-rod in the generated two-dimensional image;

~~the verification step includes a step of~~ verifying whether or not a~~the calculated~~ gap between the piston and the connecting-rod is not less than a predetermined value;

reading out, after verifying that the calculated gap is not less than the predetermined value, a three-dimensional standard piston model and connecting-rod model from a database;

deforming the piston model and the connecting-rod model on the basis of the specification values; and

determining whether or not the gap between the three-dimensional deformed piston model and the connecting-rod model is not less than the predetermined value.

6-7. (Cancelled)

8. (Currently Amended) ~~The program according to claim 1, wherein~~ A computer readable medium encoded with a computer program for supporting design of a piston shape of an engine, said program being executed by a computer to perform:

inputting specification values ~~associated with~~defining a skirt shape of the piston and a shape and position of a counter-weight ~~are input, and~~;

generating a two-dimensional image representing the piston and the counter-weight, using the specification values;

calculating a gap between the piston and the counter-weight in the generated two-dimensional image;

~~the verification step includes a step of~~ verifying whether or not a~~the calculated~~ gap between the piston and the counter-weight is not less than a predetermined value;

reading out, after verifying that the calculated gap is not less than the predetermined value, a three-dimensional standard piston model and counter-weight model from a database;

deforming the piston model and the counter-weight model on the basis of the specification values; and

determining whether or not the gap between the three-dimensional deformed piston

model and the counter-weight model is not less than the predetermined value.

9-10. (Cancelled)

11. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 1, wherein the ~~verification step~~verifying includes ~~a step of~~ reading out a verification formula from the database, substituting the specification values in the verification formula, and verifying whether or not the input-specification values are appropriate.

12. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 1, wherein said program ~~makes the computer further execute~~is executed by a computer to further perform:

~~a selection step of~~ selecting one of types which are classified depending on shapes of a surface of the piston on ~~the~~a combustion chamber side after verification ~~in the verification step~~, ~~and~~wherein

~~in that~~ the database stores the piston models in correspondence with the types, and

the ~~read step~~reading includes ~~a step of~~ reading out the three-dimensional standard piston model corresponding to the type selected in the ~~selection step~~selecting from the database.

13. (Cancelled)

14. (Currently Amended) A piston design support method for supporting design of a piston shape of an ~~internal combustion~~ engine, comprising:

~~an input step of~~ inputting specification values ~~associated with~~defining a ~~piston~~crown shape of a piston and a shape and position of a valve;

generating a two-dimensional image representing the piston and the valve, using the specification values;

calculating a gap between the piston and the valve in the generated two-dimensional image;

~~a verification step of~~ verifying~~, based on the input specification values,~~ whether or not the calculated gap~~s~~ between the piston and ~~surrounding components thereof are appropriate~~the valve in the generated two-dimensional image is not less than a predetermined value;

~~a read step of~~ reading out, ~~when~~after ~~it is determined in the verification step~~verifying that the gap~~s are appropriate~~ is not less than the predetermined value, a three-dimensional standard

piston model and valve model ~~which can be deformed according to a predetermined rule~~ from a database; ~~and~~

~~a deformation step of~~ deforming the piston model and the valve model on the basis of the specification values ~~using deformation means~~; and

determining whether or not the gap between the three-dimensional deformed piston model and the valve model is not less than the predetermined value.

15. (Currently Amended) A piston design support apparatus for supporting design of a piston shape of an ~~internal combustion~~ engine, comprising:

an input unit ~~for~~ configured to input~~ting~~ specification values ~~associated with~~defining a ~~piston~~crown shape of a piston and a shape and position of a valve;

a two-dimensional image generation unit configured to generate a two-dimensional image representing the piston and the valve, using the specification values;

a calculation unit configured to calculate a gap between the piston and the valve in the generated two-dimensional image;

a verification unit ~~for verifying, based on the input specification values,~~configured to verify whether or not the calculated gap~~s~~ between the piston and ~~surrounding components thereof are appropriate~~the valve in the generated two-dimensional image is not less than a predetermined value;

a read unit ~~for~~configured to, when said verification unit determines that the gap~~s are~~is ~~appropriate~~not less than the predetermined value, read~~ing~~ out a three-dimensional standard piston model and valve model ~~which can be deformed according to a predetermined rule~~ from a database; ~~and~~

a deformation unit ~~for~~ configured to deform~~ing~~ the piston model and the valve model on the basis of the specification values; and

a determination unit configured to determine whether or not the gap between the three-dimensional deformed piston model and the valve model is not less than the predetermined value.

16. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim ~~2~~1, wherein the ~~input step~~inputting includes ~~a step of~~ inputting, as the specification values, information associated with the piston, information associated with the valve, information associated with surfaces of a cylinder head that form a combustion chamber, and a target value of a capacity-related value which determines a capacity of the combustion chamber,

the ~~verification step~~verifying includes:

~~a recess model building step of~~ building a recess model, which opposes the valve and has a gap with the valve to satisfy a predetermined condition, on a top portion of the piston model on the basis of the information associated with the piston and the information associated with the valve input in the ~~input step~~inputting,

the ~~deformation step~~deforming includes:

~~a piston top portion model building step of~~ setting a shape of a piston top portion so that the capacity of the combustion chamber becomes a target capacity determined from the target value of the capacity-related value, and building a three-dimensional piston top portion model, on the basis of the recess model built in the recess model building ~~step~~, and the information associated with the piston, the information associated with the surfaces which form the combustion chamber, and the target value of the capacity-related value input in the ~~input step~~inputting, and

said program ~~makes the computer further execute~~is executed by a computer to further perform:

~~a valve model building step of~~ building a three-dimensional valve model on the basis of the information associated with the valve input in the ~~input step~~inputting; and

~~a gap calculation step of~~ calculating a gap between a recess of the piston top portion model built in the piston top portion model building ~~step~~ and the valve model built in the valve model building ~~step~~.

17. (Currently Amended) The program according to claim 16, wherein the recess model building ~~step~~ includes ~~a step of~~ building the recess model on a flat piston top portion.

18. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 16, wherein said program ~~makes the computer further execute~~is executed by a computer to further perform:

~~a condition determination step of~~ determining whether or not the gap calculated in the gap calculation ~~step~~ satisfies a predetermined condition of the gap between the recess and the valve in the recess model building ~~step~~; and

~~a valve model rebuilding step of~~ rebuilding, when it is determined in the condition determination ~~step~~ that the gap does not satisfy the predetermined condition, the valve model by changing at least one of a valve thickness and a slope angle of a chamfer formed at a corner portion as an intersection of a recess opposing surface and side circumferential surface so that the gap satisfies the predetermined condition.

19. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 18, wherein when the valve thickness of the valve model rebuilt in the valve rebuilding ~~step~~ is smaller than a prescribed value, said ~~program changes the~~ gap between the recess and the valve in the recess model building step is changed, and ~~makes the computer execute~~ the recess model building ~~step~~, the piston top portion model building ~~step~~, the valve model building ~~step~~, the gap calculation ~~step~~, and the condition determination ~~step~~are executed again.

20. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 16, wherein the ~~input step~~inputting includes ~~a step of~~ further inputting information associated with a position and shape of a piston ring groove to be formed on a side circumferential surface of the piston,

the ~~deformation step~~deforming includes:

~~a piston building step of~~ building a three-dimensional piston model which comprises the recess and the piston ring groove independently of or to include the piston top portion model built in the piston top portion model building ~~step~~ on the basis of the recess model built in the recess model building ~~step~~, and the information associated with the piston and the information associated with the position and shape of the piston ring groove are input in the ~~input step~~inputting, and

said program ~~makes the computer further execute~~is executed by a computer to further perform ~~a recess thickness calculation step of~~ calculating a minimum value of a thickness between the recess and the piston ring groove in the piston ring on the basis of the piston model built in the piston building ~~step~~.

21. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 16, wherein the ~~input step~~inputting includes ~~a step of~~ further inputting information associated with at least a shape of a piston ring groove to be formed on a side circumferential surface of the piston,

the ~~deformation step~~deforming includes:

~~a piston building step of~~ building a three-dimensional piston model which comprises the recess independently of or to include the piston top portion model built in the piston top portion model building ~~step~~ on the basis of the recess model built in the recess model building ~~step~~, and the information associated with the piston in the ~~input step~~inputting, and

said program ~~makes the computer further execute a groove position calculation step of~~is

executed by a computer to further perform calculating a position of the piston ring groove on the basis of the piston model built in the piston building ~~step~~ and the information associated with the shape of the piston ring groove input in the ~~input step~~inputting so that a minimum value of a thickness between the recess in the piston model and the piston ring groove is not less than a predetermined value.

22. (Currently Amended) The method according to claim 14, wherein the ~~input step~~inputting includes ~~a step of~~ inputting, as the specification values, information associated with the piston, information associated with the valve, information associated with surfaces of a cylinder head that form a combustion chamber, and a target value of a capacity-related value which determines a capacity of the combustion chamber,

the ~~verification step~~verifying includes:

~~a recess model building step of~~ building a recess model, which opposes the valve and has a gap with the valve to satisfy a predetermined condition, on a top portion of the piston model on the basis of the information associated with the piston and the information associated with the valve input in the ~~input step~~inputting,

the ~~deformation step~~deforming includes:

~~a piston top portion model building step of~~ setting a shape of a piston top portion so that the capacity of the combustion chamber becomes a target capacity determined from the target value of the capacity-related value, and building a three-dimensional piston top portion model, on the basis of the recess model built in the recess model building ~~step~~, and the information associated with the piston, the information associated with the surfaces which form the combustion chamber, and the target value of the capacity-related value input in the ~~input step~~inputting, and

said method further comprises:

~~a valve model building step of~~ building a three-dimensional valve model on the basis of the information associated with the valve input in the ~~input step~~inputting; and

~~a gap calculation step of~~ calculating a gap between a recess of the piston top portion model built in the piston top portion model building ~~step~~ and the valve model built in the valve model building ~~step~~.

23. (Currently Amended) The apparatus according to claim 15, wherein said input unit inputs, as the specification values, information associated with the piston, information associated with the valve, information associated with surfaces of a cylinder head that form a combustion chamber, and a target value of a capacity-related value which determines a capacity

of the combustion chamber, and

said verification unit comprises:

a recess model building unit ~~for~~configured to build~~ing~~ a recess model, which opposes the valve and has a gap with the valve to satisfy a predetermined condition, on a top portion of the piston model on the basis of the information associated with the piston and the information associated with the valve input by said input unit;

a piston top portion model building unit ~~for~~configured to set~~ting~~ a shape of a piston top portion so that the capacity of the combustion chamber becomes a target capacity determined from the target value of the capacity-related value, and building a three-dimensional piston top portion model, on the basis of the recess model built by said recess model building unit, and the information associated with the piston, the information associated with the surfaces which form the combustion chamber, and the target value of the capacity-related value input by said input unit;

a valve model building unit ~~for~~configured to build~~ing~~ a three-dimensional valve model on the basis of the information associated with the valve input by said input unit;

a gap calculation unit ~~for~~configured to ~~calculating~~calculate a gap between a recess of the piston top portion model built by said piston top portion model building unit and the valve model built by said valve model building unit; and

a gap verification unit ~~for~~configured to verify~~ing~~ whether or not the gap calculated by said gap calculation unit falls within a predetermined range.

24. (Currently Amended) A ~~piston design support program~~computer readable medium encoded with a computer program for supporting design of a piston shape of an ~~internal combustion~~ engine, ~~by making a computer execute~~ said program being executed by a computer to perform:

~~an input step of~~ inputting specification values ~~associated with~~defining a ~~piston~~crown type and shape of a piston;

~~a read step of~~ reading out ~~a~~an intake-side piston model having an intake-side recess, and an intake valve mode~~which can be deformed according to a predetermined rule,~~ from a database, which stores a plurality of intake-side piston models and a plurality of exhaust-side piston models, independently, in accordance with crown types of the piston;~~ and~~

~~a deformation step of~~ deforming the intake-side piston model ~~on the basis of~~using the specification values input in the ~~input step~~inputting, so as to prevent interference between the intake-side recess and the intake valve model~~,~~;

further reading out an exhaust-side piston model having an exhaust-side recess, and an

exhaust valve mode from the database;

further deforming the exhaust-side piston model using the specification values input in the inputting, so as to prevent interference between the exhaust-side recess and the exhaust valve model; and

combining the deformed intake-side piston model and the deformed exhaust-side piston model

~~wherein the piston model includes an intake-side piston model which includes an intake-side recess formed to prevent interference with an intake valve, and an exhaust-side piston model which includes an exhaust-side recess formed to prevent interference with an exhaust valve, and~~

~~the deformation step includes a step of deforming both the intake- and exhaust-side piston models and combining the deformed intake- and exhaust-side piston models~~.

25. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 24, wherein the ~~intake- and exhaust-side~~ intake-side and exhaust-side piston models are segmented in accordance with symmetry, and

the ~~deformation step~~deforming includes ~~a step of~~ combining the ~~intake- and exhaust-side~~ intake-side and exhaust-side piston models, and mirroring the combined model in accordance with the symmetry.

26. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 24, wherein the specification values include crown types indicating if a surface of the piston on ~~the~~a combustion chamber side has a convex or recess shape~~,~~

~~the database stores a plurality of intake-side piston models and a plurality of exhaust-side piston models in correspondence with the crown types, and~~

~~the read step includes a step of reading out from the database the intake- and exhaust-side piston models corresponding to the crown type input in the input step as the specification value~~.

27. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 24, wherein the ~~deformation step~~deforming includes ~~a step of~~:

deforming, when dimensions associated with the entire piston are input as the specification values, both the ~~intake- and exhaust-side~~intake-side and exhaust-side piston

models in correspondence with each other.

28. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 24, ~~which makes computer further execute a display step of~~wherein said program is executed by a computer to further perform displaying a piston model obtained by combining the ~~intake- and exhaust-side~~intake-side and exhaust-side piston models in the ~~deformation step~~deforming while hiding connected surfaces of the ~~intake- and exhaust-side~~intake-side and exhaust-side piston models.

29. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 24, wherein the intake-side recess included in the intake-side piston model and the exhaust-side recess included in the exhaust-side piston model use different shape determination rules upon determining shapes of the intake-side and exhaust-side recesses on the basis of a recess depth input as the specification value.

30. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 29, wherein the ~~input step~~inputting includes ~~a step of~~ inputting an intake-side recess depth and an exhaust-side recess depth, and

the shapes of the intake-side and exhaust-side recesses are determined to have different slopes of bottom surfaces even when identical values are input as the intake-side and exhaust-side recess depths in the ~~input step~~inputting.

31. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 29, wherein the ~~input step~~inputting includes ~~a step of~~ inputting an intake-side recess depth and an exhaust-side recess depth, and

the shapes of the intake-side and exhaust-side recesses are determined to have different curvatures of corners formed by bottom surfaces and side surfaces thereof even when identical values are input as the intake-side and exhaust-side recess depths in the ~~input step~~inputting.

32. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 29, wherein when the intake-side and exhaust-side recess depths input in the ~~input step~~inputting have changed, the shape of the intake-side recess is determined to change at least one of a slope of a bottom surface and a curvature of a corner formed by the bottom surface and a side surface thereof, but the shape of the exhaust-side recess is determined to change neither of a slope of a bottom surface and a curvature of a

corner formed by the bottom surface and a side surface thereof.

33. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 24, wherein the ~~input step~~inputting includes ~~a step of~~ inputting a target compression ratio as the specification value, and

the ~~deformation step~~deforming includes ~~a step of~~ deforming the piston model in accordance with the target compression ratio input in the ~~input step~~inputting.

34. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 33, ~~which makes the computer further execute~~wherein said program is executed by a computer to further perform:

~~a compression ratio calculation step of~~ calculating a compression ratio of the piston model deformed in the ~~deformation step~~deforming, and

wherein a piston shape closest to the target compression ratio input in the ~~input step~~inputting is determined by repeating the ~~deformation step~~deforming and the compression ratio calculation ~~step~~.

35. (Currently Amended) A ~~piston design support program~~computer readable medium encoded with a computer program for supporting design of a piston shape of an ~~internal combustion~~ engine, ~~by making a computer execute~~said program being executed by a computer to perform:

~~an input step of~~ inputting specification values ~~associated with~~defining a piston shape;

~~a read step of~~ reading out a main body piston model, which ~~can be deformed according to a predetermined rule,~~represents a shape of a surface of the piston, from a database, which stores a plurality of main body piston models and a plurality of space models independently; ~~and~~

~~a deformation step of~~ deforming the main body piston model ~~on the basis of~~using the specification values input in the ~~input step~~inputting~~,~~;

further reading out a space model, which represents a space shape to be carved out from the main body model, from the database;

further deforming the space model using the specification values; and

carving out the deformed space model from the deformed main body piston model

~~wherein the database includes, as the piston model, a main body model which represents a shape of a surface of the piston on the combustion chamber side, and a space model which represents a space shape to be shaved from the main body model, and~~

~~the deformation step includes a step of deforming both the main body model and the~~

~~space model in accordance with the specification values, and shaving the main body model into a shape expressed by the space model.~~

36. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 35, wherein the space model includes a skirt inner space model which represents a shape inside a skirt of the piston.

37. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 35, wherein the space model includes a skirt outer space model which represents a shape of a skirt outer surface of the piston.

38. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 35, wherein the space model includes a pin hole space model which represents a shape of a pin hole that receives a pin used to hold a connecting rod.

39. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 35, wherein the ~~input step~~inputting includes ~~a step of~~ inputting dimensions of the entire piston as the specification values, and

the ~~deformation step~~deforming includes ~~a step of~~ deforming the main body model and the space model in accordance with the dimensions of the entire piston, and shaving the space model from the main body model.

40. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 36, wherein the ~~input step~~inputting includes ~~a step of~~ inputting a thickness of the piston as the specification value, and

the ~~deformation step~~deforming includes ~~a step of~~ shaving the skirt inner space model from the main body model while laying out the skirt inner space model at a position separated from the main body model by a distance corresponding to the thickness input in the ~~input step~~inputting.

41. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 36, wherein the ~~input step~~inputting includes ~~a step of~~ inputting dimensions that determine a shape of the skirt inner space model, and a minimum thickness of the piston as the specification values, and

the ~~deformation step~~deforming includes ~~a step of~~ producing error information or

performing re-deformation when a thickness of a piston model generated by deforming the skirt inner space model in accordance with the specification values input in the ~~input step~~inputting, and shaving the skirt inner space model from the main body model becomes not more than the minimum thickness.

42. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 35, wherein the main body model includes an intake-side piston model which includes an intake-side recess formed to prevent interference with an intake valve, and an exhaust-side piston model which includes an exhaust-side recess formed to prevent interference with an exhaust valve, and

the ~~deformation step~~deforming includes ~~a step of~~ deforming both the intake-side and exhaust-side piston models and combining the deformed intake-side and exhaust-side piston models.

43. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 42, wherein the intake-side and exhaust-side piston models are segmented in accordance with symmetry, and

the ~~deformation step~~deforming includes ~~a step of~~ combining the intake-side and exhaust-side piston models, and mirroring the combined model in accordance with the symmetry.

44. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 36, wherein the ~~input step~~inputting includes ~~a step of~~ inputting a target compression ratio as the specification value,

the skirt inner space model includes a portion that represents a space shape of a crown back surface, and

the ~~deformation step~~deforming includes ~~a step of~~ increasing a curvature of the crown back surface of the skirt inner space model with increasing target compression ratio input in the ~~input step~~inputting.

45. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 36, wherein the ~~input step~~inputting includes ~~a step of~~ inputting a pin boss gap as the specification value,

the skirt inner space model includes a portion that represents a space shape of a crown back surface, and

the ~~deformation step~~deforming includes ~~a step of~~ increasing a curvature of the crown

back surface of the skirt inner space model with decreasing pin boss gap input in the ~~input step~~inputting.

46. (Currently Amended) The ~~program~~computer readable medium encoded with a computer program according to claim 36, wherein the ~~input step~~inputting includes ~~a step of~~ inputting a skirt inner diameter as the specification value,

the skirt inner space model includes a portion that represents a space shape of a crown back surface, and

the ~~deformation step~~deforming includes ~~a step of~~ increasing a curvature of the crown back surface of the skirt inner space model with decreasing skirt inner diameter input in the ~~input step~~inputting.